Structured Decision Making: Brucellosis & Elk Management

Mike Mitchell

Montana Cooperative Wildlife Research Unit

University of Montana

mike.mitchell@umontana.edu

243-4390

Decision making:

Something needs to be done…

… but what?

A decision is….

An irrevocable allocation of resources.

Budgets
Personnel
Workload
Programs
Regulations

No Decision *is* a Decision
(for the Status Quo)

Decision making:

- Fact: we're all pretty good at it…
  - … always?
  - Individually?
  - As a group?
- Decisions are often not as good as they need to be
- Why?
  - Human nature…
  - Where problems are complex
  - Where decision-making process is informal, untransparent
  - Where competing agendas exist
- Solution…?

Structured Decision Making…

- A formal application of common sense for situations too complex for the informal use of common sense (R. Keeney)

Common sense example

- *Objective*: maintain healthy populations of native species in longleaf pine savannah ecosystem
  - *Approach*: maintain open canopy with grass/forb understory
- Actions
  - Alternatives:
    - Prescribed fire
    - Mechanical thinning
    - Herbicides
  - Timing:
    - Frequency?
    - Conditions?

Common sense example

- Requires understanding of the system
  - How overstory and understory vegetation change as a result of treatments and frequency of application
- Management solution(s) should
  - Integrate objectives, actions, and system understanding
- Challenge: identify action and timing that best achieves objective

So what's so hard?

- Actions
  - Alternatives:
    - Prescribed fire
    - Mechanical thinning
  - Timing:
    - Frequency?
    - Conditions?
- Understanding of how overstory and understory vegetation change as a result of treatments and frequency of application

What if others exist?

What if there is uncertainty about these?

What if there is debate about whether this understanding is correct?

Or worst of all…!

- *Objective*: maintain healthy populations of native species in longleaf pine savannah ecosystem
  - *Approach*: maintain open canopy with grass/forb understory

What if decision-makers don't agree on these, know they even exist, or have them confused?!

Formal common sense

- Structured decision making
  - Formal method for analyzing a decision
    - By breaking it into its logical components
  - Helps identify impediments to a decision
    - Allows focus on the right parts
  - Explicitness and transparency
    - Allows control of the process → better performance
    - Process robust to scrutiny

A way of thinking

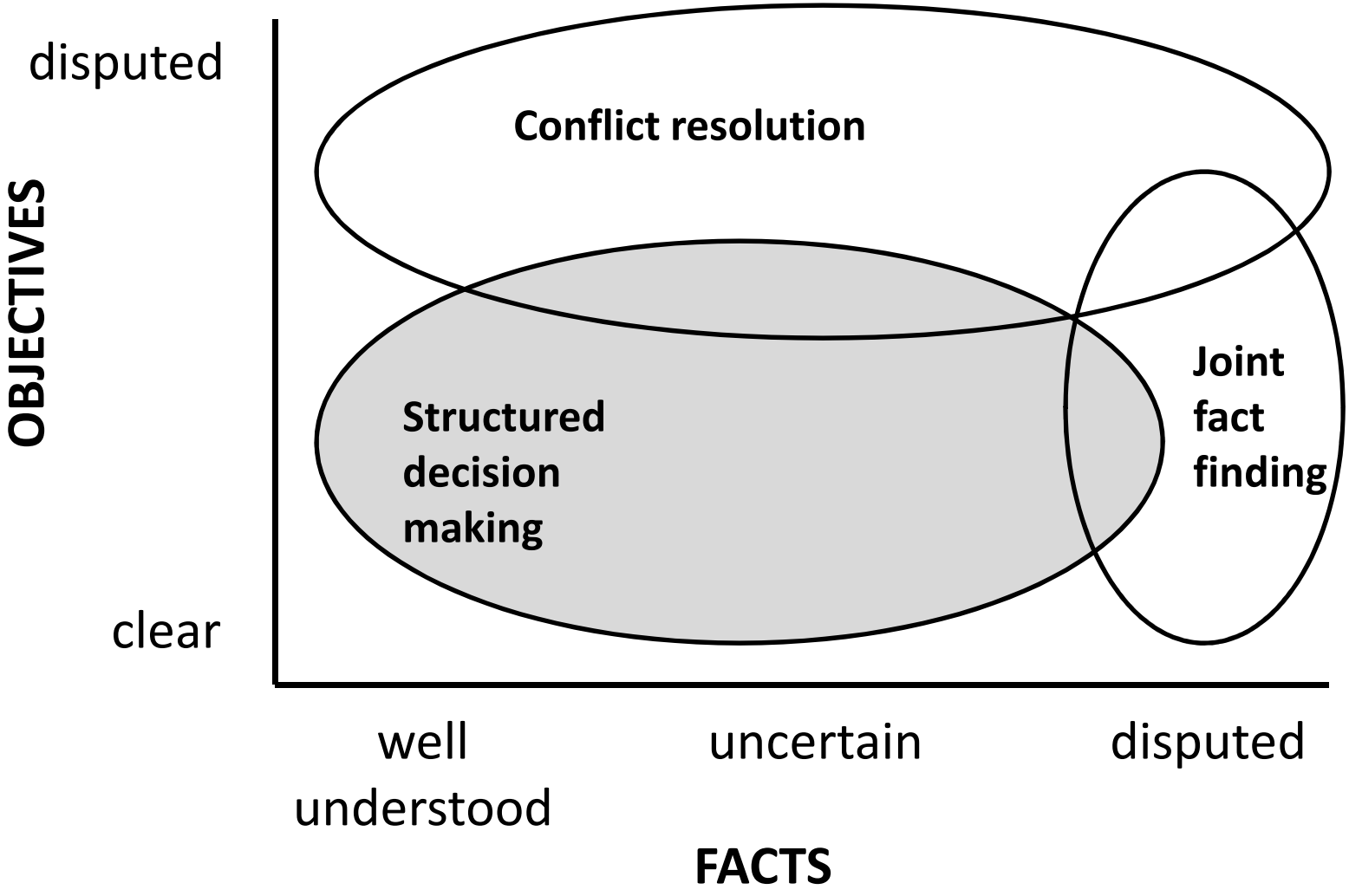
- Formalizes the very human process of making decisions
  - Nothing new, no re-created wheels here
  - Mental discipline
- Does NOT make the decision– clarifies it
  - Facilitates judgment of the decision maker based on all available information
  - Not a black box

Benefits

- Decisions that are:
  - Transparent
  - Explicit
  - Deliberative
  - Able to be documented
  - Replicable

Defensible, Clear, Consensus-building

When is structured decision making appropriate?



How is it done?

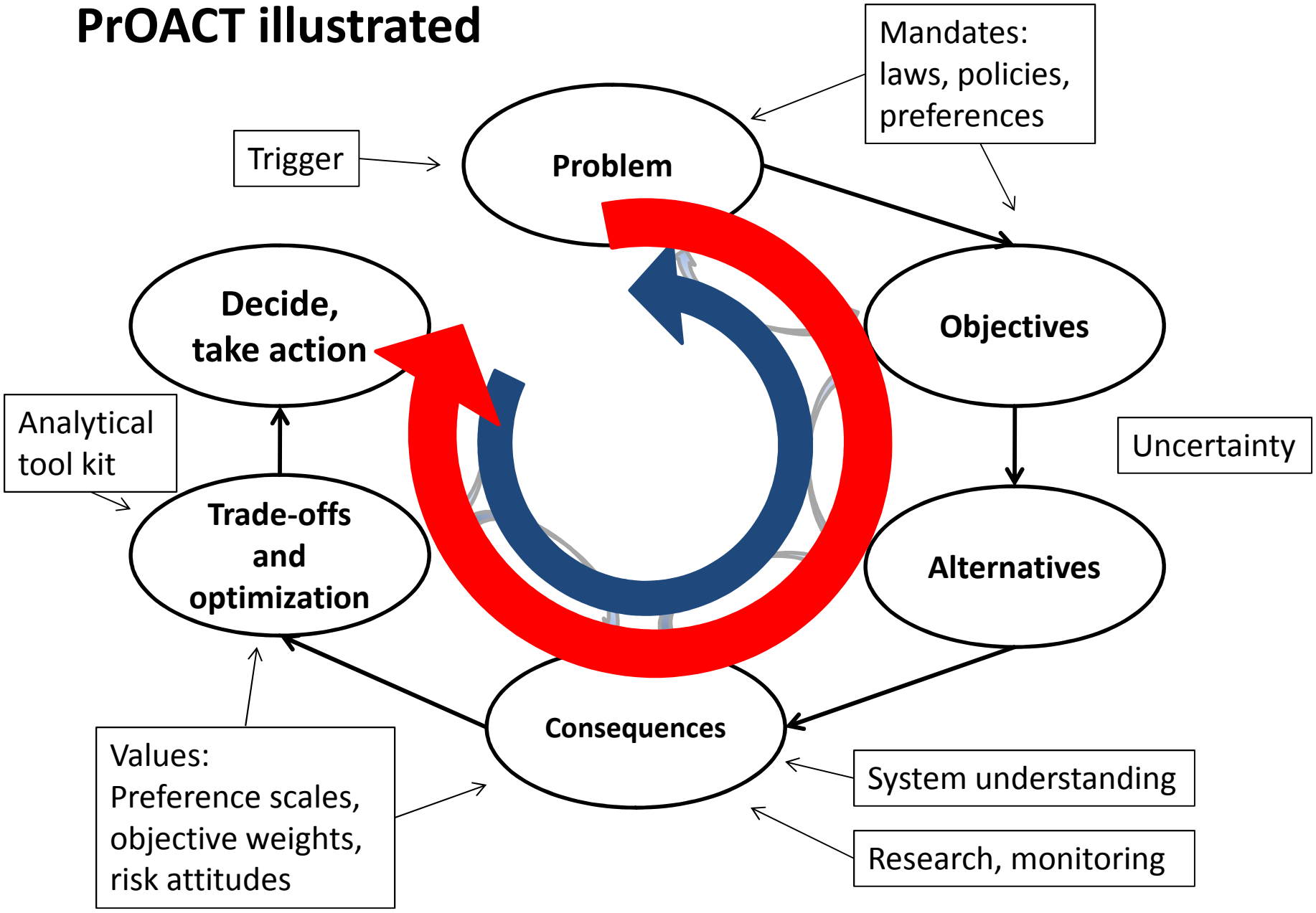
- **Pr**oblem
- **O**bjectives
- **A**lternatives or actions
- **C**onsequences (predictive step)
- **T**rade-offs and optimization (decision analysis step)

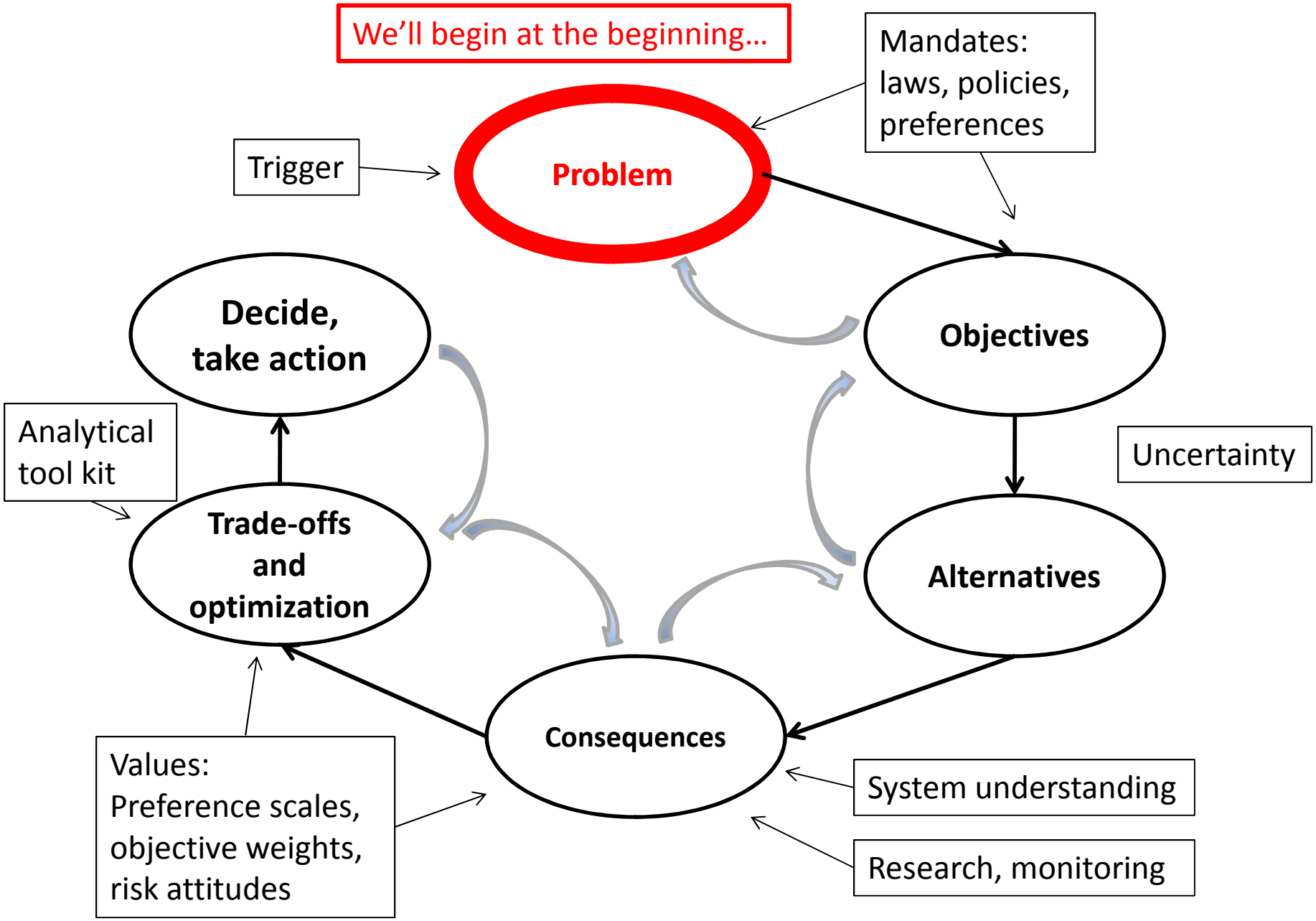
Missing these
Critical first steps…

Where people
tend to start

- **PrOACT**

PrOACT illustrated




We'll begin at the beginning…
Mandates: laws, policies, preferences
Trigger
Problem
Objectives
Uncertainty
Alternatives
Consequences
System understanding
Research, monitoring
Values: Preference scales, objective weights, risk attitudes
Trade-offs and optimization
Analytical tool kit
Decide, take action

Defining the Problem

- Critical first step in structured decision making
- Seems simple, but can be surprisingly difficult and frustrating
- Without it:
  - Solve the wrong problem
  - Use the wrong tools and information
  - Invest in the wrong solution
  - Risk: decision and its context are misunderstood

Problem

- *Extra time to craft a concise yet comprehensive and accurate problem definition pays off…*
- **Make sure we're solving the right problem!**
  - Foundation for all subsequent steps
  - Guides process toward appropriate tools and information
  - Determines appropriate level of investment
- May not be obvious
  - May need a couple of laps around the SDM track…
  - Especially in complicated public sector problems

Problem definition:

- Action
  - What action needs to be taken?
  - What is the decision?
- Trigger
  - Why does this decision matter?
- Legal
  - What are the legal constraints?
  - Perceived or real?
- Decision maker ← **Critical**
  - Who will make (and take responsibility for) the decision?

Problem definition:

- Frequency and timing
  - Are other decisions linked to this one?
  - Will this decision need to be made again?
- Scope
  - How broad or complicated is the decision?
- Goals
  - How many?
  - Do they conflict?
  - Are some goals simply constraints?
- Uncertainty
  - How critical?
  - Can it be ignored?

Problem definition:

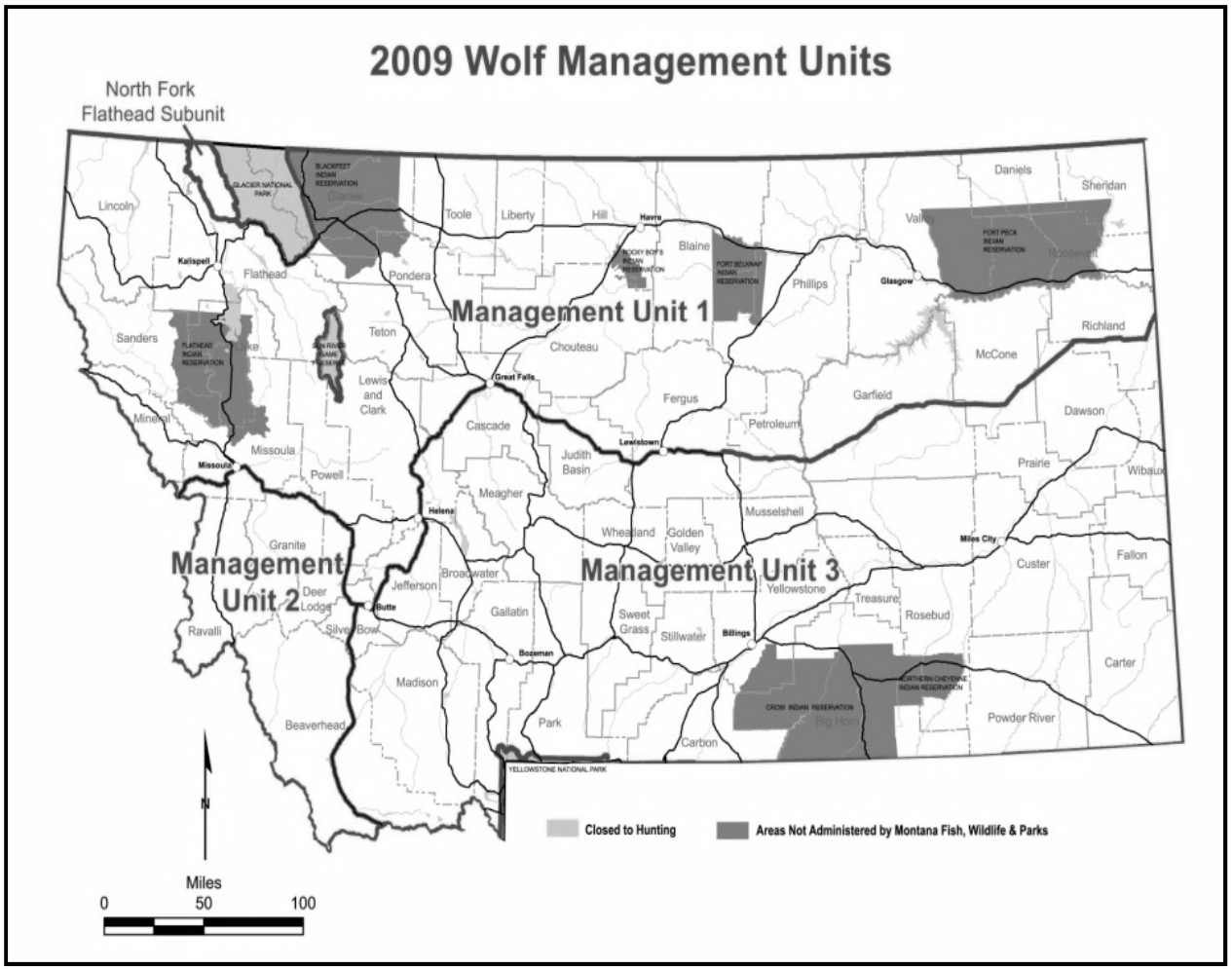
- Think outside of the box– brainstorm!
- Don’t be bound by the past
- Question assumed constraints
- Create first, evaluate later (take good notes!)
- Look for precedents-- consider similar problems
- Remember who will make the decision
- Review, revisit, revise repeatedly

Important:

- The problem statement needs to end with ***how*** the problem will be solved
  - Not in detail– but generally
  - Ex: Meeting population objectives for nongame species will be achieved by enhancing habitat quality
- Sets sideboards on alternatives
- Stimulates discussion/ideas
- Can/should/will be revised as needed

Example of SDM application:

Defining wolf management units for Montana

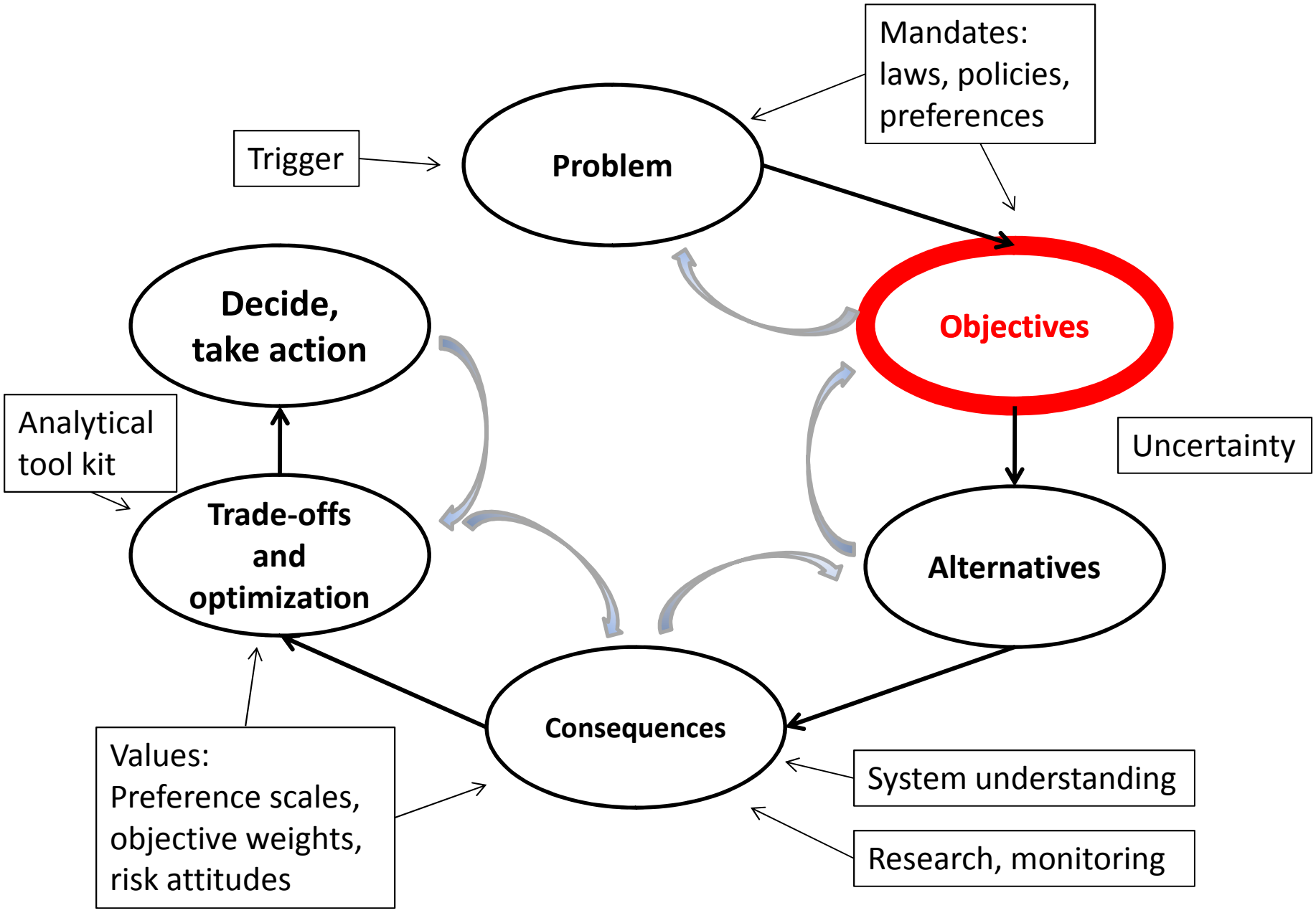


Decision scenario

- For the 2009 hunting season, MFWP had defined 3 WMUs
- Managers believed that smaller, redistributed WMUs in that portion of the state was needed
  - manage allocation of hunter opportunity
  - distribution of harvest
- Statutory obligations and public contention presented a challenging context
- MFWP elected to use SDM process
  - ensure explicit consideration of all relevant factors affecting the decision
  - provide transparency to the public.

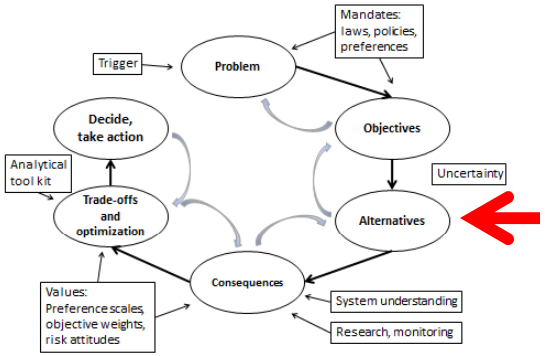
Problem statement:

FWP must propose a 2010 wolf harvest strategy that maintains a recovered and connected wolf population, minimizes wolf-livestock conflicts, reduces wolf impacts on low or declining ungulate populations and ungulate hunting opportunities, and effectively communicates to all parties the relevance and credibility of the harvest while acknowledging the diversity of values among those parties.


Mandates:
laws, policies,
preferences
Trigger
Problem
Objectives
Decide,
take action
Analytical
tool kit
Uncertainty
Trade-offs
and
optimization
Alternatives
Consequences
Values:
Preference scales,
objective weights,
risk attitudes
System understanding
Research, monitoring

Objectives

- What we really care about
- Well defined objectives critical:
  - Create alternatives
  - Compare alternatives
  - Choose pertinent information
  - Explain decisions to others
- Must be unambiguous
- ALL subsequent steps build on these, so…



For good objectives:

1. Articulate concerns
   - Why is this decision a problem?
   - Why is it hard to make this decision?
   - What are we trying to achieve?
   - What are the critical concerns?
   - What is the best possible outcome?
   - The worst?
   - If we make a decision, what will we avoid?
   - If we make no decision, what will happen?

For good objectives:

2. Convert concerns into objectives
   - State objectives as verb and object

Concern	Potential objective
It's hard to catch bluegills anymore	Restore panfish populations
Many loons die ingesting lead tackle	Eliminate lead in tackle
Ballast water brings invasive species	Prohibit ballast dumping
We're not talking with landowners	Increase communication
I won't have enough money for this	Minimize cost

For good objectives

3. Distinguish between:
   - Strategic
     - Winning the war vs. taking the hill
   - Fundamental = “this is where we want to go”
     - What is the bottom line?
     - What do we really care about?
   - Means = “this is how we get there”
     - What methods will we use?
- Good decisions are based on ***fundamental objectives***

Getting to *fundamental objectives*

- Ask, and keep asking, “why?”
- When the answer is:
  - “Just because…”
  - “It’s the law.”
  - “This is important.”
  - “Inherent value.”

  We have reached a fundamental objective
- *In other words…what constitutes successful outcome(s) for the decision?*

Getting to *means objectives*

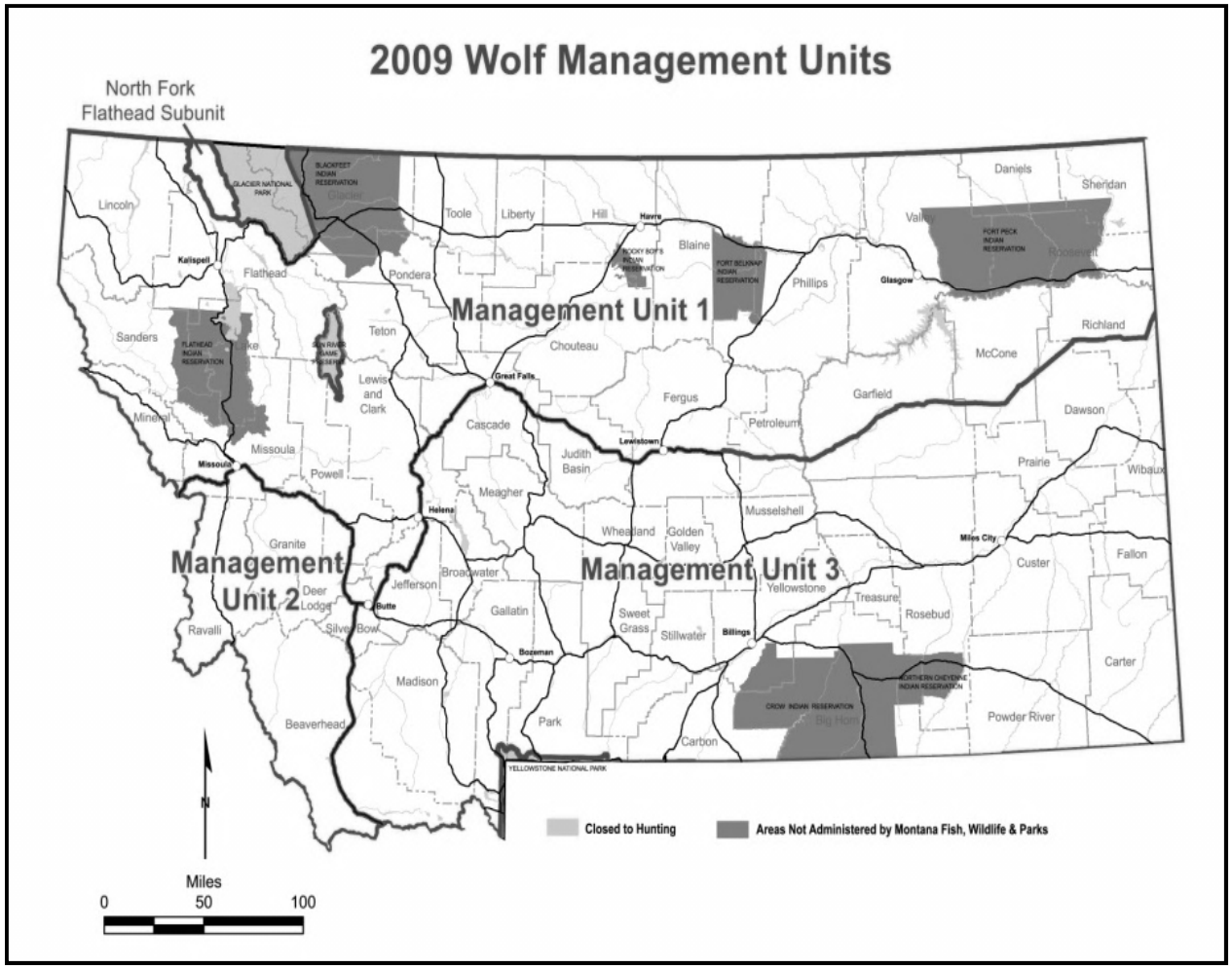
- Ask, and keep asking, “How?”
  - How can we address this concern?
  - How can we measure success?
  - How can we make the stakeholders happy?
- Remember: decision will be based on fundamental objectives
  - Means objectives will be useful for defining alternatives in the next step

Once fundamental objectives identified:

- Assign measurable attributes
- How is success measured?
  - Natural measure (e.g., $ for “minimize costs”)
  - Constructed measure (e.g., scale of 1 to 5 for public satisfaction)
  - Proxy (e.g., amount of habitat for persistence of a non-game species)
- Assign desired direction
  - Increase (e.g., for “maximize biodiversity”)
  - Decrease (e.g., for “minimize costs”)
  - Stay the same

Back to:

Defining wolf management units for Montana



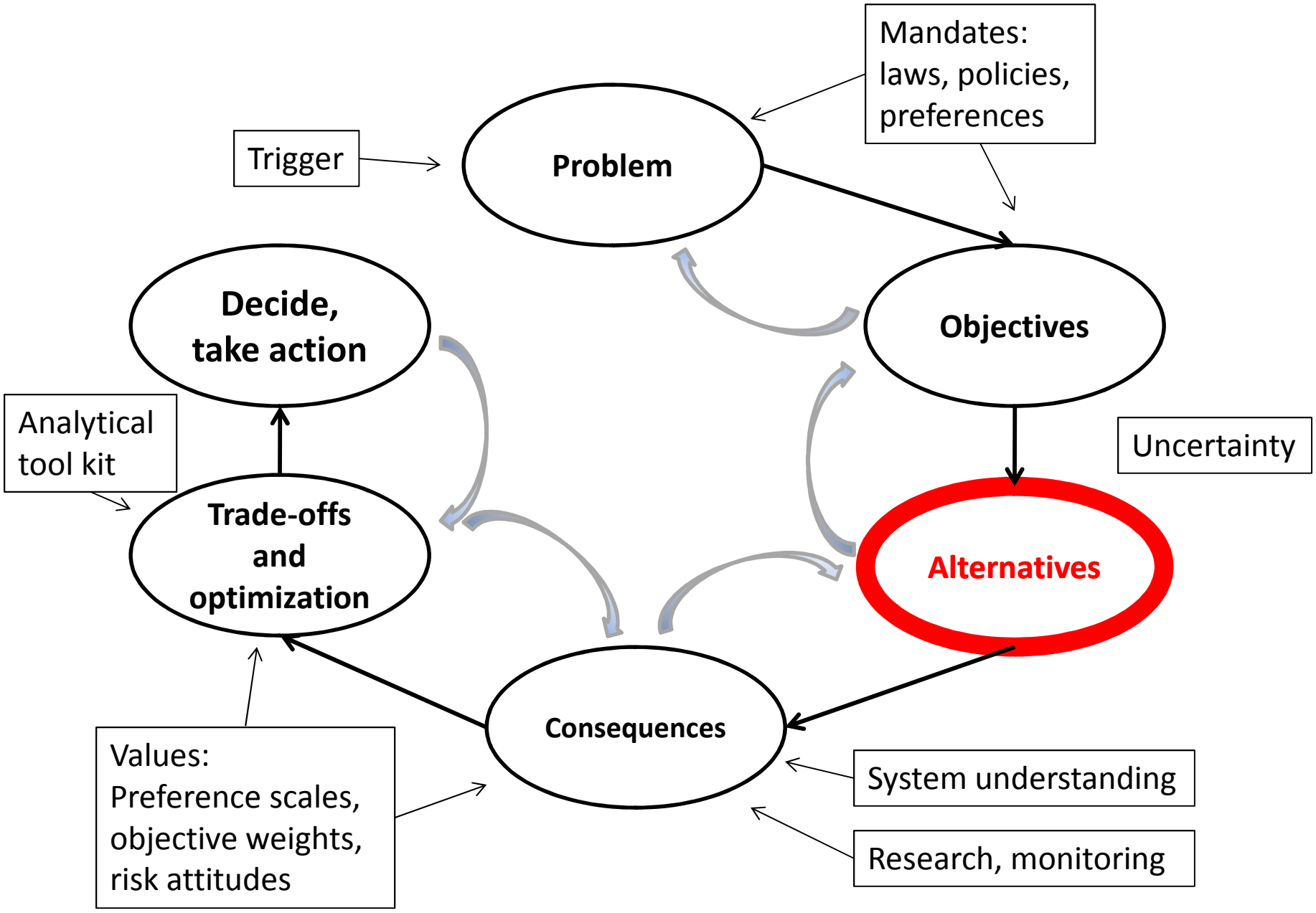
Fundamental objectives:

- 1. Maintain a viable and connected wolf population in Montana.
- 2. Gain and maintain authority for State of Montana to manage wolves.
- 3. Maintain positive and effective working relationships with livestock producers, hunters, and other stakeholders.
- 4a. Reduce wolf impacts on livestock.
- 4b. Reduce wolf impacts on big game populations.
- 4c. Maintain sustainable hunter opportunity for wolves.
- 4d. Maintain sustainable hunter opportunity for ungulates.
- 5. Increase broad public acceptance of sustainable harvest and hunter opportunity as part of wolf conservation.
- 6. Enhance open and effective communication to better inform decisions
- 7. Learn and improve as we go.

Measurable attributes:

Fundamental Objective	Measurable Attribute		Preferred Direction
Maintain relationships			
Livestock producer	perception	0 to 1	Maximize
Stakeholders	perception	0 to 1	Maximize
Hunters	perception	0 to 1	Maximize
Reduce impacts			
to big game	ungulate populations at or near objectives	Yes (1) /No (0)	Maximize
to livestock	reduce number confirmed injury or death loss	0 to 1	Maximize
Public acceptance	perception	0 to 1	Maximize
Sustainable ungulate harvest	quota in every WMU for foreseeable future	Yes (1) /No (0)	Maximize

Note: not all of the fundamental objectives from previous slide listed here: Sometimes only a subset prove useful for making the decision


Mandates:
laws, policies,
preferences
Trigger
Problem
Decide,
take action
Objectives
Analytical
tool kit
Uncertainty
Trade-offs
and
optimization
Alternatives
Consequences
Values:
Preference scales,
objective weights,
risk attitudes
System understanding
Research, monitoring

Alternatives

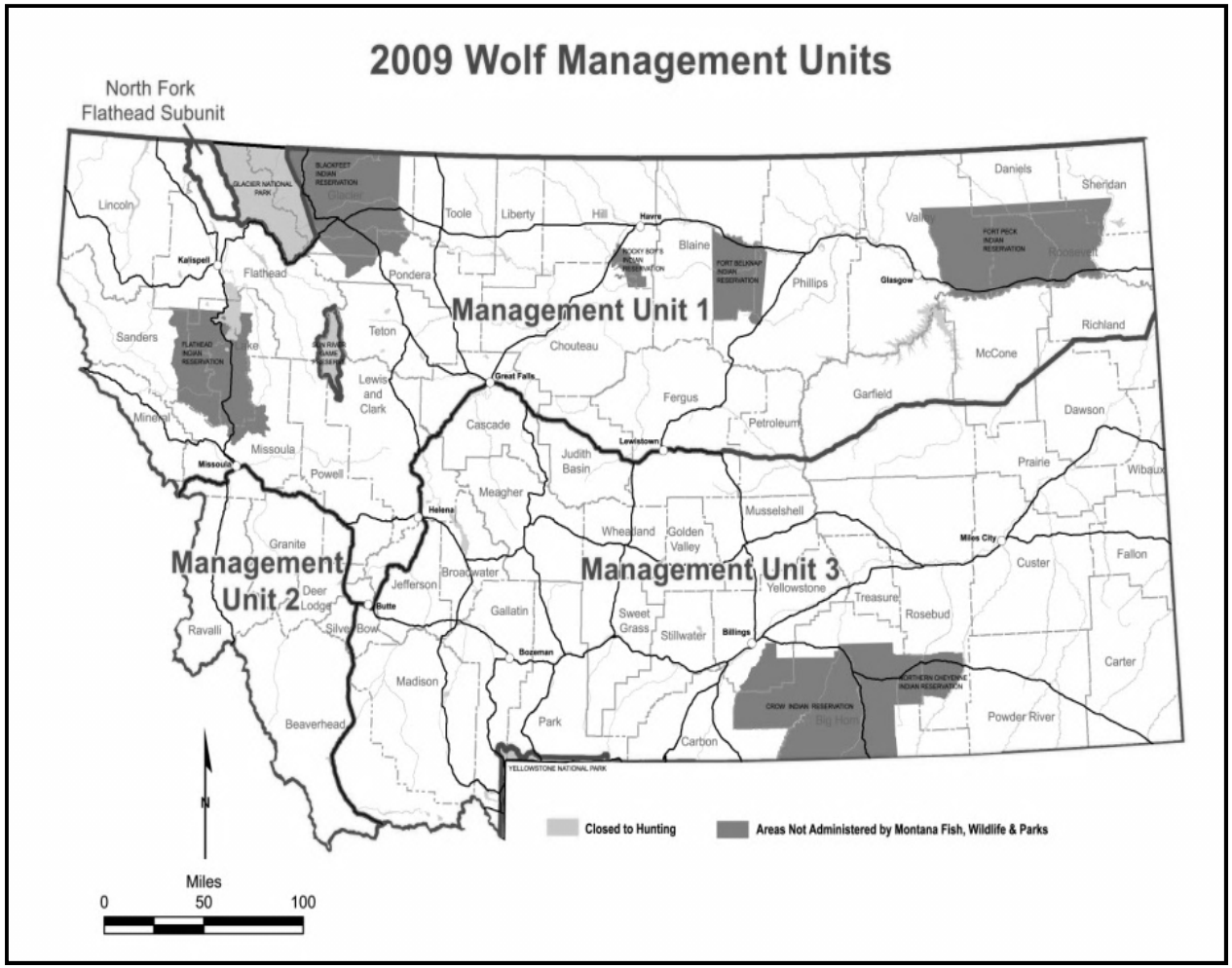
- Created after we have decided on fundamental objectives
- Figure out things that we can do to meet them:
  - Options
  - Solutions
  - Management actions

Good alternatives

- Address the future, not the past
- Are unique
- Are creative
  - Encompass a broad range of possible actions
- Are financially, legally, and politically reasonable
- Can actually be implemented by the decision maker
- Address all objectives

Back to:

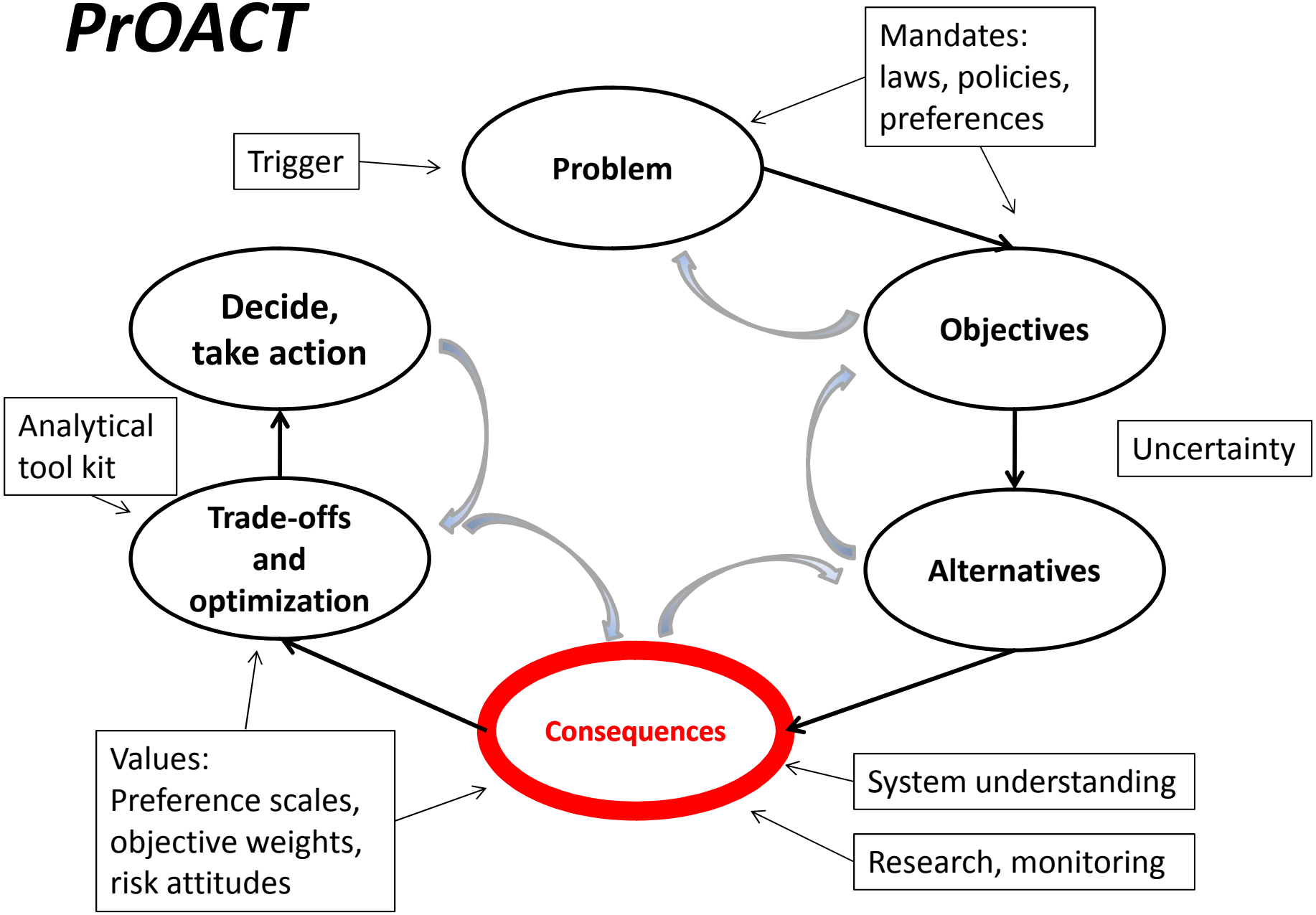
Defining wolf management units for Montana



Alternatives:

- Alt 1: Status quo, 3 WMUs
- Alt 2: 15 WMUs with eastern Montana incorporated into western units.
- Alt 3: 14 WMUs with eastern Montana incorporated into western units.
- Alt 4: 13 WMUs with eastern Montana incorporated into western units.
- Alt 5: 15 WMUs with eastern Montana having its own management unit not incorporated into western units.

PrOACT


Mandates:
laws, policies,
preferences
Trigger
Problem
Decide,
take action
Objectives
Analytical
tool kit
Uncertainty
Trade-offs
and
optimization
Alternatives
Consequences
Values:
Preference scales,
objective weights,
risk attitudes
System understanding
Research, monitoring

Consequences

- Predicting the outcome for each objective under each alternative
  - Relative contributions of actions to objectives
  - Improves transparency of judgments
  - Recognizes trade-offs and uncertainties
  - Separates values from facts
  - Provides framework for communication/discussion
  - Provides insight but doesn't "make" the decision
- Consequences table…

Let's return:
Common sense example

- *Problem:* We need to cost-effectively maintain healthy populations of native species in longleaf pine savannah ecosystem.
- *Fundamental objectives*:
  - Maintain grass/forb understory
  - Retain open canopy
  - Increase richness of native species
  - Minimize costs
  - Ensure social acceptability
- *Alternatives:*
  - Prescribed fire
  - Mechanical thinning
  - Herbicides

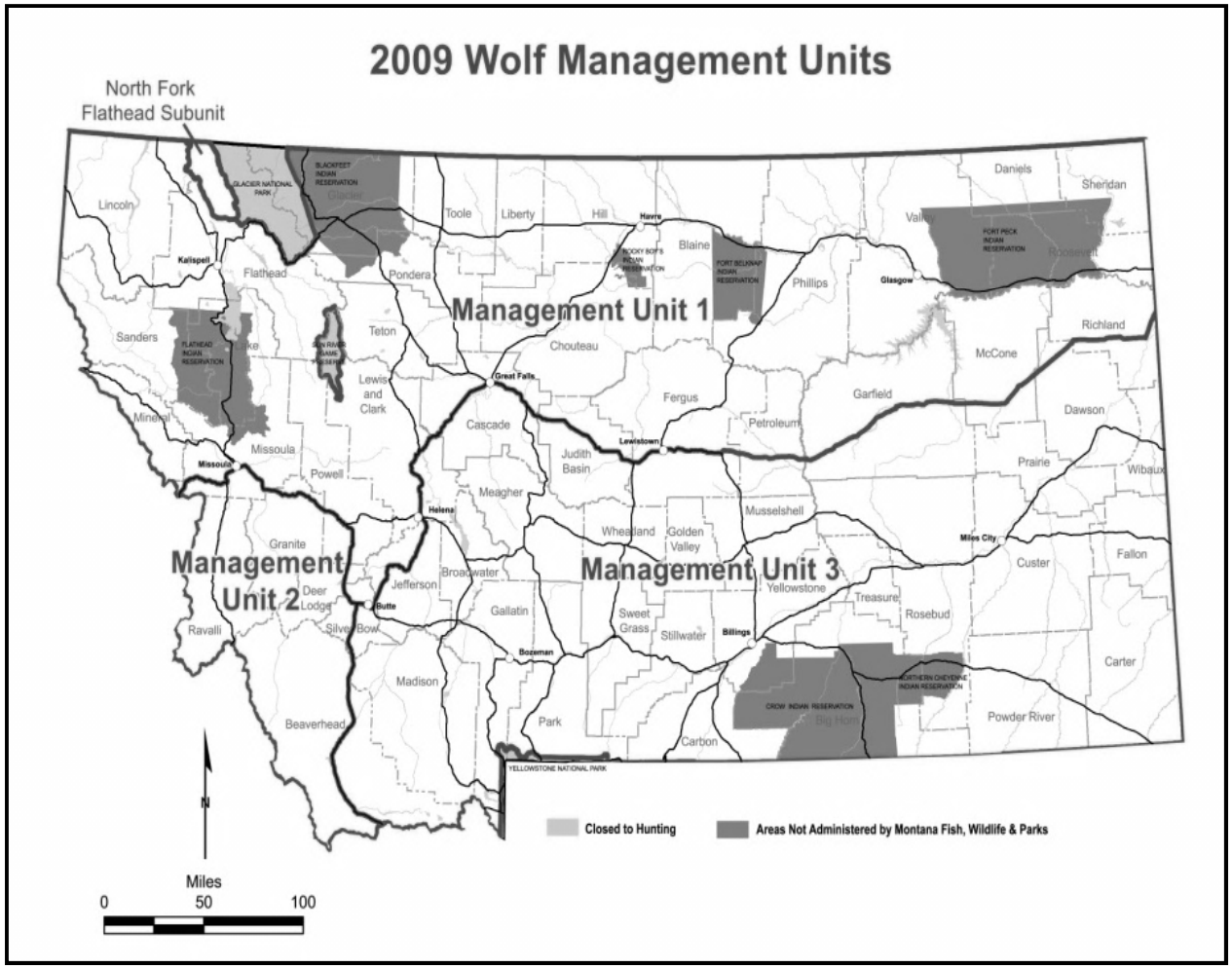
Consequence table

MAINTAIN LONGLEAF PINE SAVANNAH:			**Alternatives**		
Objective	**Measure**	**Direction**	**Prescribed fire**	**Mechanical thinning**	**Herbicide**
Grass/forb understory	%	↑	70	50	60
Canopy closure	%	↓	20	20	20
Native species	Richness	↑	15	10	10
Cost	$	↓	$75K	$150K	$100K
Social acceptability	1-5	↑	2	2	4

Here's where the consequences of each management alternative for each fundamental objective are predicted.

Back to:

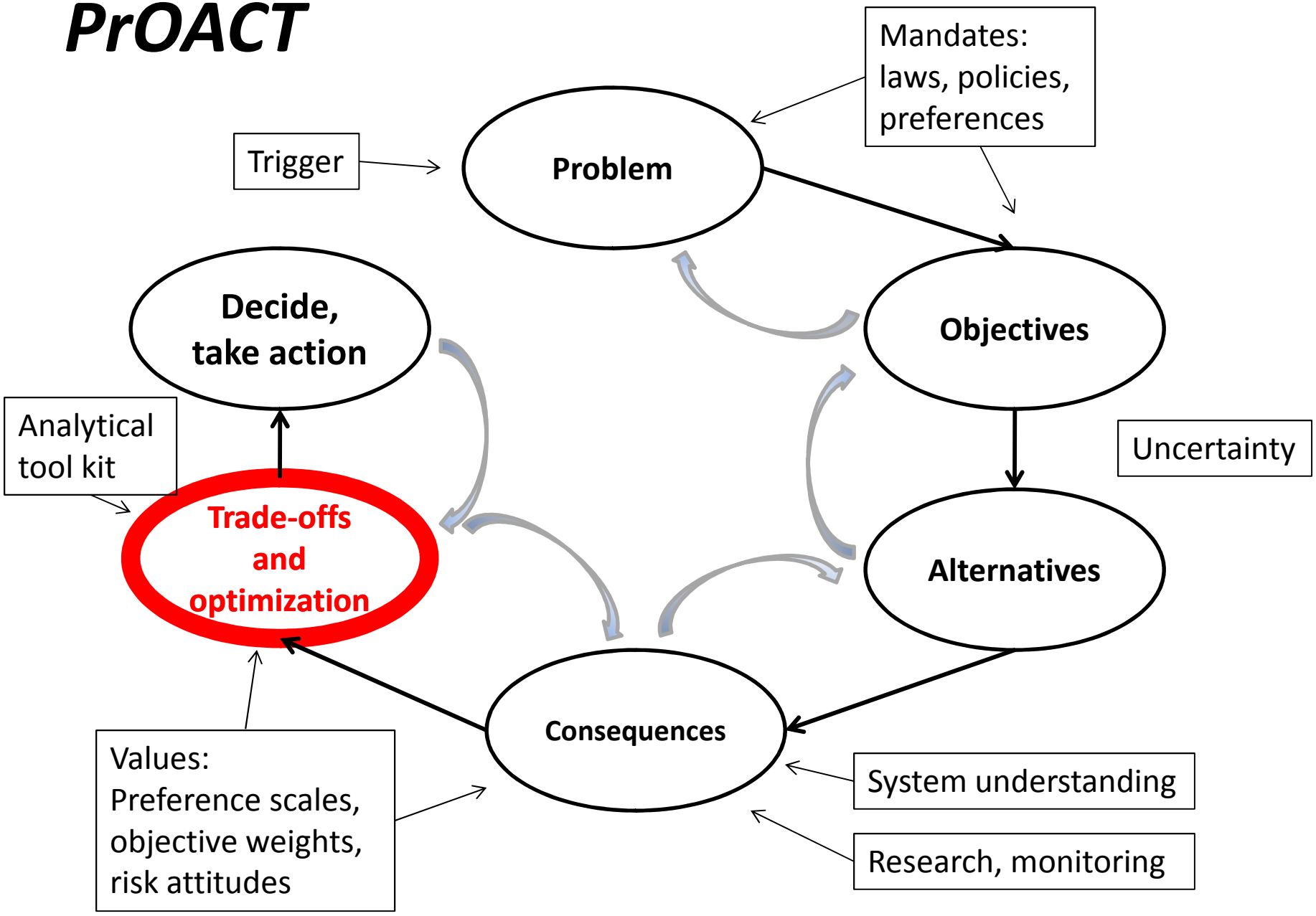
Defining wolf management units for Montana



Consequences:

Fundamental Objective	Measurable Attribute		Preferred Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Maintain relationships								
Livestock producer	perception	0 to 1	Maximize	0.83	0.54	0.66	0.66	0.63
	perception	0 to 1	Maximize	0.69	0.60	0.66	0.66	0.34
Stakeholders								
Hunters	perception	0 to 1	Maximize	0.80	0.57	0.83	0.77	0.60
Reduce impacts								
to big game	ungulate populations at or near objectives	Yes (1) /No (0)	Maximize	0.60	1.00	1.00	0.80	1.00
to livestock	reduction in the number of livestock confirmed injured or killed by wolves	0 to 1	Maximize	0.56	0.72	0.80	0.80	0.76
Public acceptance	perception	0 to 1	Maximize	0.80	0.72	0.74	0.74	0.37
Sustainable ungulate harvest	quota in every WMU for foreseeable future	Yes (1) /No (0)	Maximize	0.60	1.00	1.00	0.80	1.00

PrOACT


Mandates:
laws, policies,
preferences
Trigger
Problem
Decide,
take action
Objectives
Analytical
tool kit
Uncertainty
Trade-offs
and
optimization
Alternatives
Consequences
Values:
Preference scales,
objective weights,
risk attitudes
System understanding
Research, monitoring

Trade-offs

- Evaluation of alternatives based on relative consequences for objectives
- Judgment of the decision maker based on all available information
  - Transparent, comprehensive, explicit, best available information, managed uncertainty
  - Not an algorithm for making decisions for decision makers

Let's return:
Common sense example

- *Problem:* We need to cost-effectively maintain healthy populations of native species in longleaf pine savannah ecosystem.
- *Fundamental objectives*:
  - Maintain grass/forb understory
  - Retain open canopy
  - Increase richness of native species
  - Minimize costs
  - Ensure social acceptability
- *Alternatives:*
  - Prescribed fire
  - Mechanical thinning
  - Herbicides

Trade-offs: *consequence table*

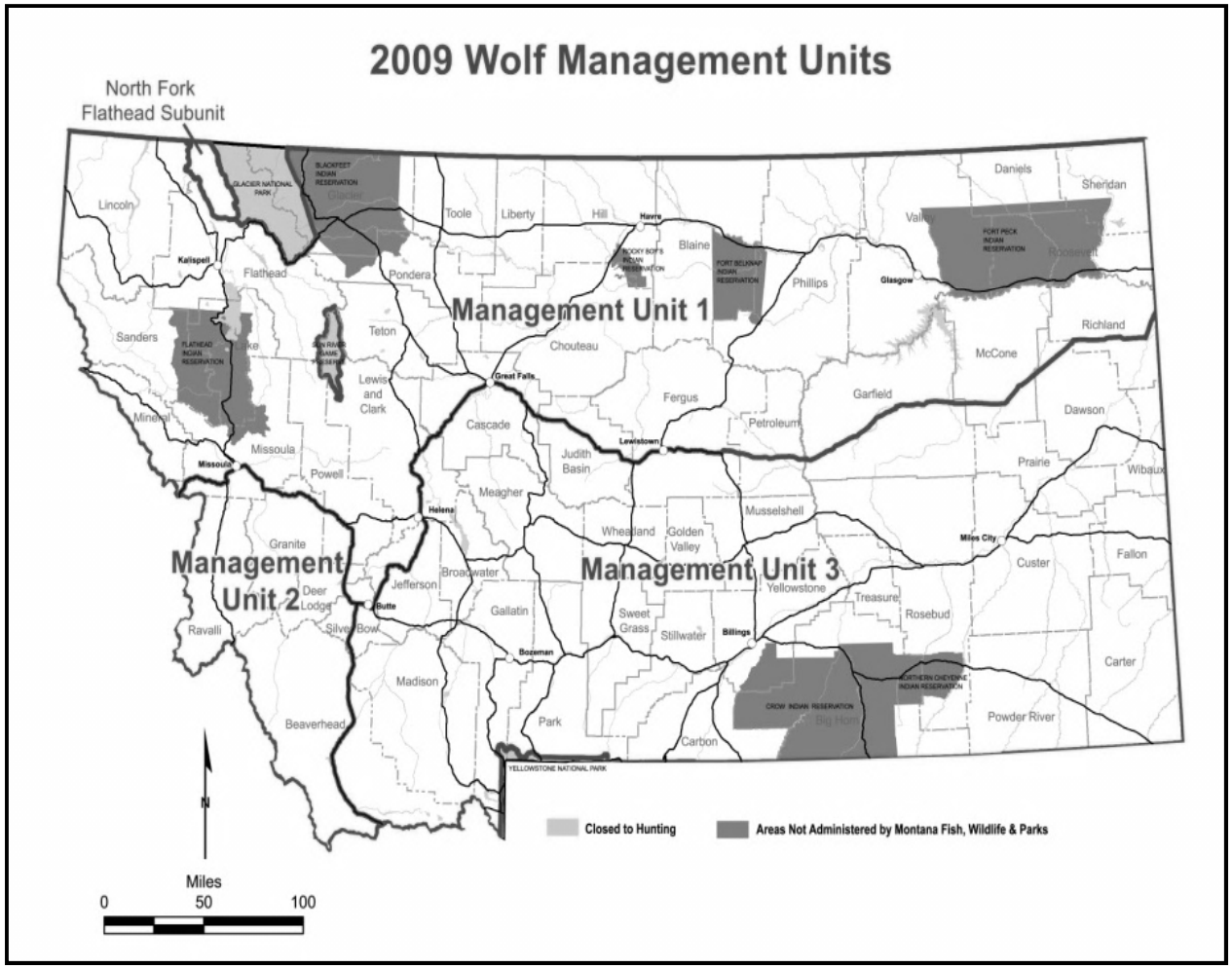
MAINTAIN LONGLEAF PINE SAVANNAH:			Alternatives		
Objective	**Measure**	**Direction**	**Prescribed fire**	**Mechanical thinning**	**Herbicide**
Grass/forb understory	%	↑	70	50	60
Canopy closure	%	↓	20	20	20
Native species	Richness	↑	15	10	10
Cost	$	↓	$75K	$150K	$100K
Social acceptability	1-5	↑	2	2	4

The decision just got simpler!

Of the remaining alternatives, which is best?

Back to :

Defining wolf management units for Montana

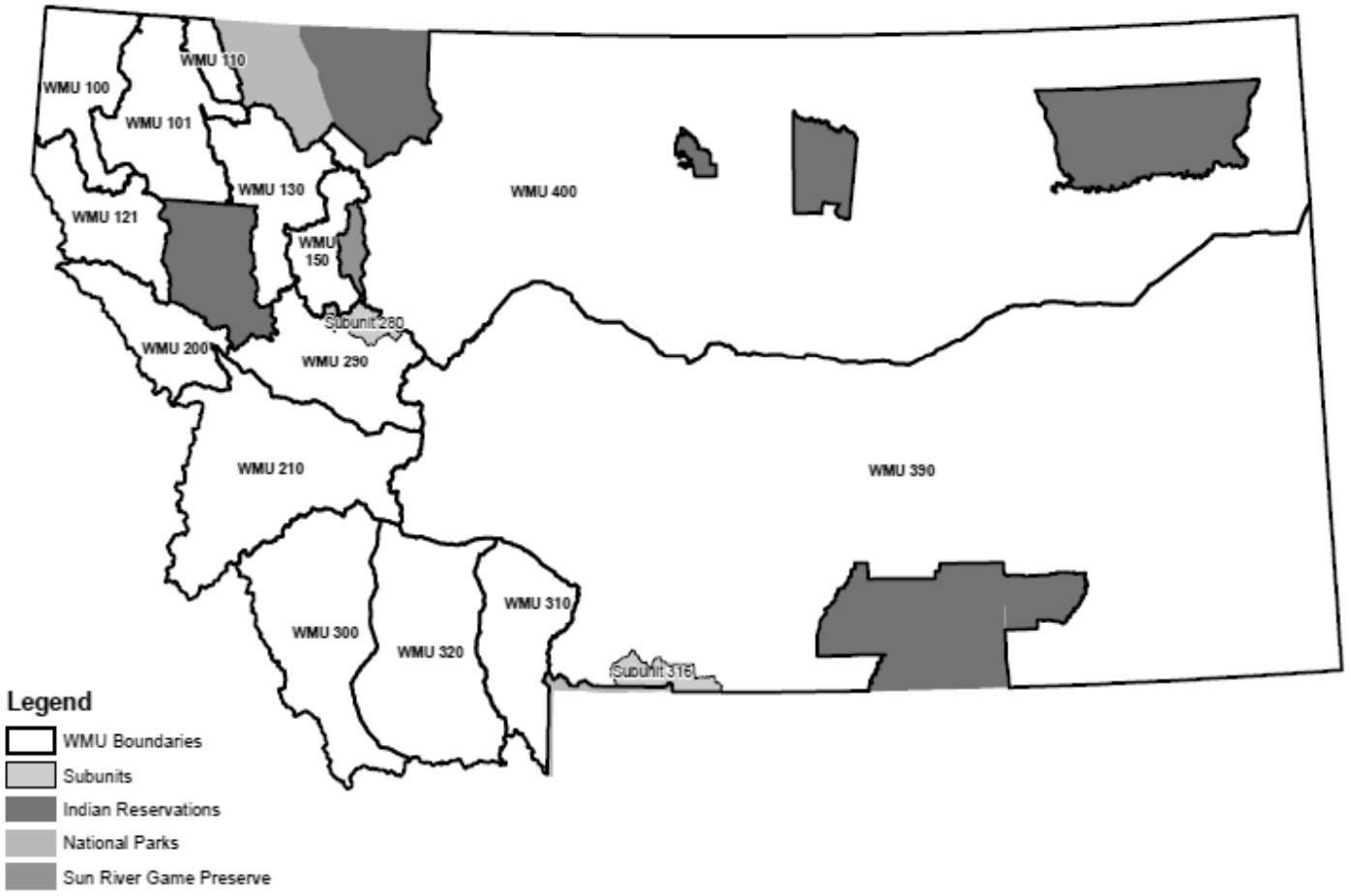


Trade-offs:

What alternative would you choose? …why?

Fundamental Objective	Measurable Attribute		Preferred Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Maintain relationships								
Livestock producer	perception	0 to 1	Maximize	0.83	0.54	0.66	0.66	0.63
Stakeholders	perception	0 to 1	Maximize	0.69	0.60	0.66	0.66	0.34
Hunters	perception	0 to 1	Maximize	0.80	0.57	0.83	0.77	0.60
Reduce impacts								
to big game	ungulate populations at or near objectives	Yes (1) /No (0)	Maximize	0.60	1.00	1.00	0.80	1.00
to livestock	reduction in the number of livestock confirmed injured or killed by wolves	0 to 1	Maximize	0.56	0.72	0.80	0.80	0.76
Public acceptance	perception	0 to 1	Maximize	0.80	0.72	0.74	0.74	0.37
Sustainable ungulate harvest	quota in every WMU for foreseeable future	Yes (1) /No (0)	Maximize	0.60	1.00	1.00	0.80	1.00

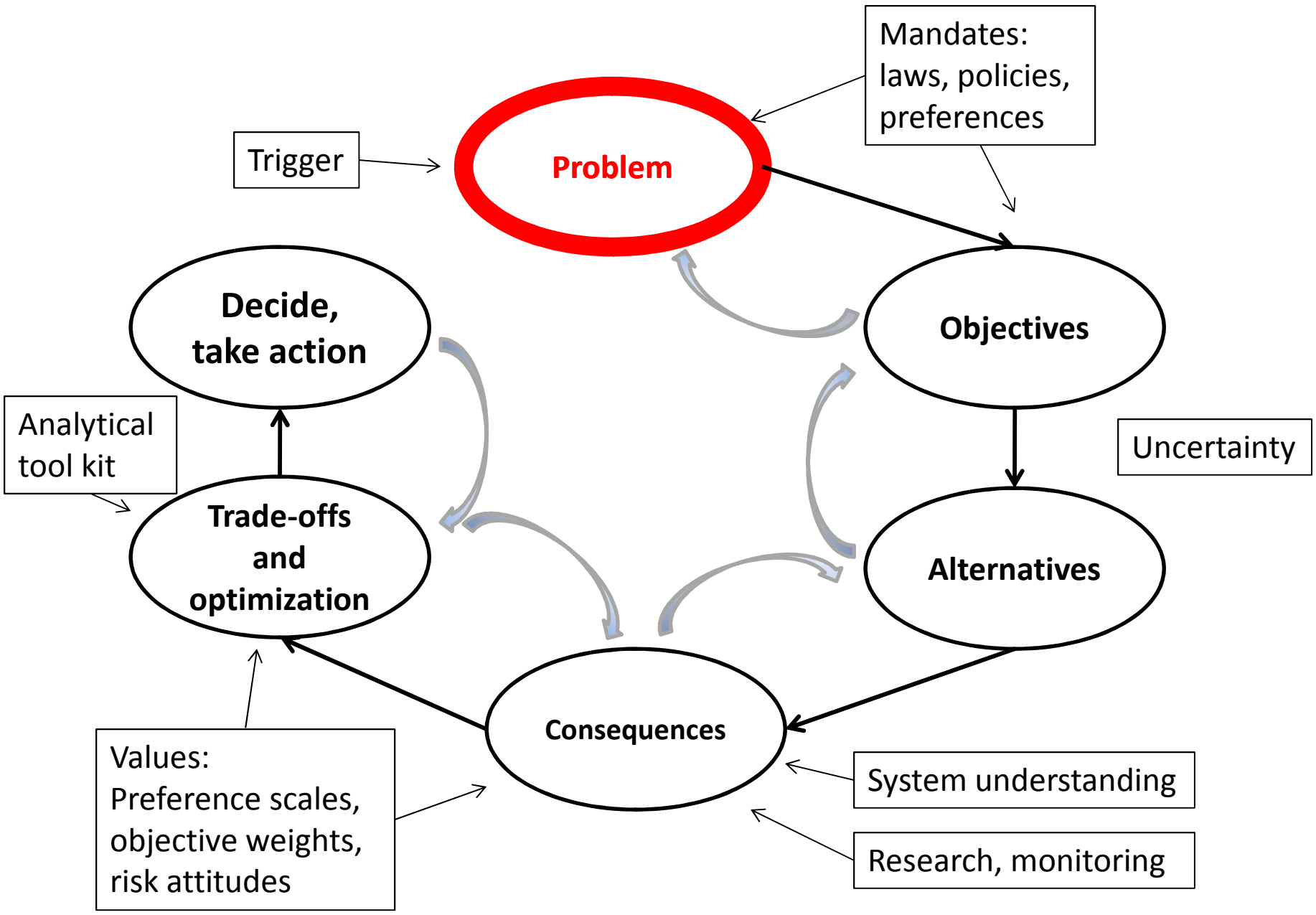
What alternative 3 looked like:



You survived…

To begin…

- What we're here to do:
  - Solve a difficult problem
  - Using the process of Structured Decision Making
- Rules of the road:
  - Honor the process
  - Mutual respect
  - Stay on course
  - Consensus


Mandates:
laws, policies,
preferences
Trigger
Problem
Decide,
take action
Objectives
Analytical
tool kit
Uncertainty
Trade-offs
and
optimization
Alternatives
Consequences
Values:
Preference scales,
objective weights,
risk attitudes
System understanding
Research, monitoring

Example

Elk archery regulations in the Breaks and surrounding districts

Elk archery: Problem Statement

The FWP Commission implemented limited-entry archery elk hunting regulations in the Missouri River Breaks and 22 other districts with limited-entry rifle elk hunting regulations beginning in 2008. The purpose of these regulations included equitable allocation of elk hunting opportunity among user groups, consistent application of regulations across districts, minimization of crowding, minimization of hunter displacement to other districts, and maximization of the ability to manage elk herds within specified objectives using antlerless elk harvest during the general season. The limited entry regulations have been very controversial since their implementation in 2008. The FWP Commission now needs to establish elk archery regulations for 2012/2013 and every 2 years thereafter due to the biennial season-setting timeline. This timeline affords them the opportunity to learn from the implementation of the 2008 season and every subsequent decision. Their decisions will affect the balance among bow and rifle hunter opportunities, hunter desires for freedom of opportunity and hunt quality, private landowner options for managing hunter access on their property, landowner and outfitter business models that have relied on predictable license allocations and exclusive access to elk, communities that have derived economic benefits from elk hunters, and consistency and understandability of regulations. In making the decisions, the FWP Commission will have to consider the ability to obtain sufficient, well-distributed cow elk harvest to meet laws requiring them to manage elk within objectives, resident and non-resident hunter numbers, and the variable nature of the hunting districts to which the regulations have been applied.

Start here…

- Why is this difficult?
- Why is there discontent/debate?
  - Who
  - What
  - Where
  - When
  - Why
  - How
- Why not just make the decision?

Problem definition

- Action
  - What action needs to be taken?
  - What is the decision?
- Trigger
  - Why does this decision matter?
- Legal
  - What are the legal constraints?
  - Perceived or real?
- Decision maker
  - Who will make the decision?
- Frequency and timing
  - Are other decisions linked to this one?
  - Will this decision need to be made again?
- Scope
  - How broad or complicated is the decision?
- Goals
  - How many?
  - Do they conflict?
  - Are some goals simply constraints?
- Uncertainty
  - How critical?
  - Can it be ignored?